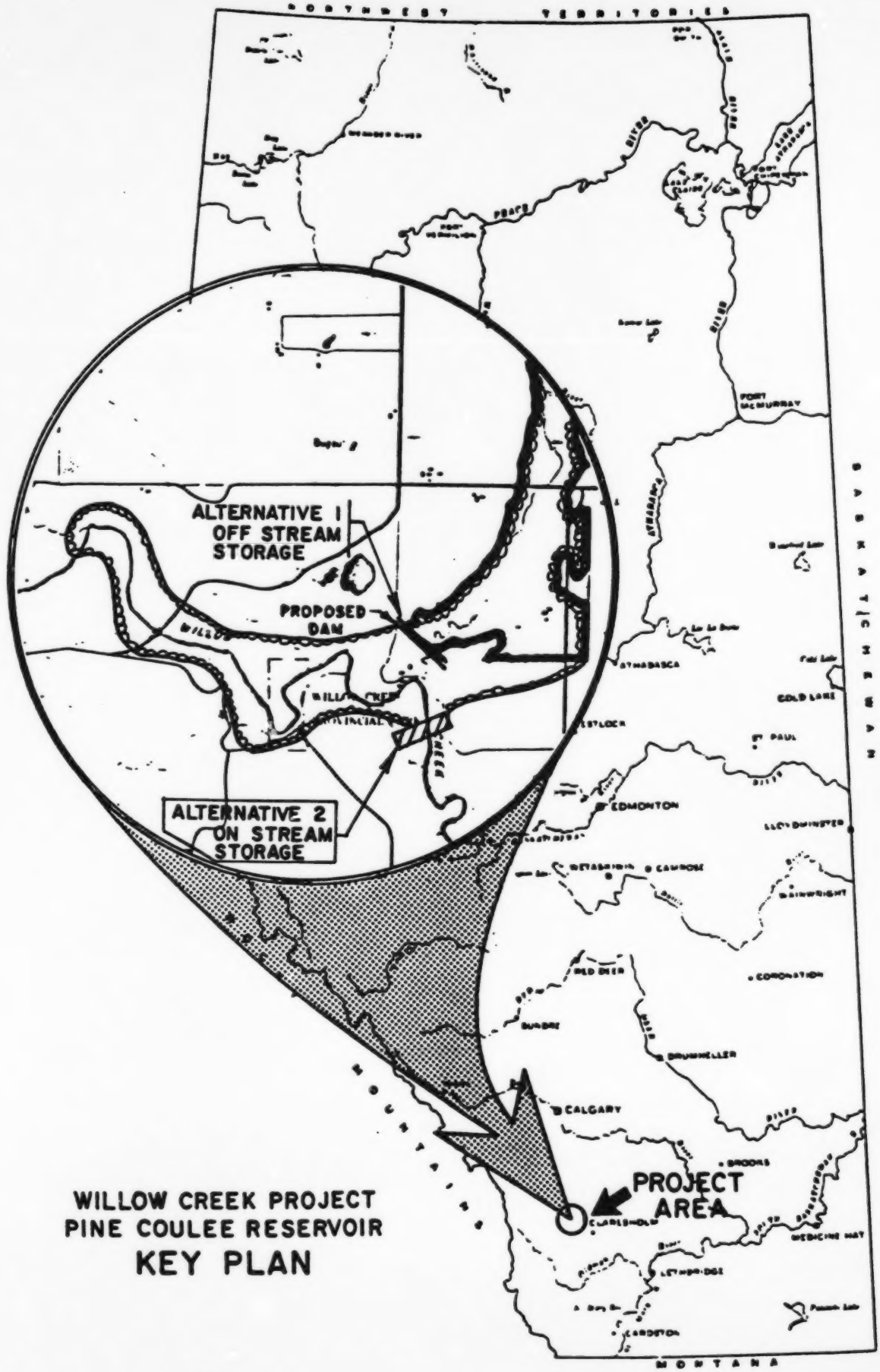
ALBERTA ENVIRONMENT

WATER RESOURCES MANAGEMENT SERVICES

DESIGN AND CONSTRUCTION DIVISION

DESIGN BRANCH

Willow Creek Basin
Pine Coulee Reservoir
Alternative 2, On-Stream Storage
Executive Summary
November 1985



WILLOW CREEK PROJECT
PINE COULEE RESERVOIR
KEY PLAN

PINE COULEE RESERVOIR

ALTERNATIVE 2, ON-STREAM STORAGE

SUMMARY

This summary highlights the design component prepared under the frame work of a feasibility study on water storage in Pine Coulee. Water will be stored simultaneously in the Coulee and Willow Creek by a dam embankment across Willow Creek and a saddle dyke. This arrangement is designated as "Pine Coulee Reservoir, Alternative 2, On-Stream Storage". The design study and cost estimate were requested by the Oldman River Basin Planner.

1) **Data and Information Available**

- 1984 Preliminary Planning Study Report, provided by Planning Division.
- 1:5000 and 1:2000 Scale Contour Maps, provided by Survey Branch.
- Level I Hydrology Report and Natural Flow for Willow Creek Basin provided by Hydrology Branch.
- Minimum Freeboard Against Wave Run-up, provided by River Engineering.

2) **Layout**

The on-stream alternative consists of a dam embankment on Willow Creek at a site about 200 m downstream of the junction with Pine Creek, a saddle dyke along the southeast periphery of the reservoir, two major crossings of Pine Coulee and Willow Creek for Highway #527 and a minor coulee crossing for the E-W road near the northern end of the reservoir. Other structures associated with the dam embankment are the service spillway located at the right abutment, the outlet works located at the left abutment and the emergency spillway incorporated with the saddle dyke. Horizontal and vertical alignments of dykes and dam will have the equivalence of a rural market road, designated as RLU-208-80 by Alberta Transportation.

3) **Reservoir Capacity and Area**

The reservoir will provide a gross capacity of about 58,000 ac. ft. and a flooded area of about 1,150 acres.

4) **Design Floods**

According to the 1983 Dam and Canal Safety guidelines, the reservoir and dam embankment are classified as large in size and low in hazard potential. The project flood selected is 0.5 PMF. For flow diversion during construction of the dam embankment, the choice of a design construction flood is a compromise between economy and safety. From an arbitrary approach, if the critical part of the diversion period does not exceed one year then the flood that has only a 10% chance of being exceeded should be acceptable. The dam construction flood will be confirmed by a detailed river diversion scheme.

5) **Upstream Slope Protection**

The upstream slope of all earth fill structures is subjected to wave erosion generated by wind action. The 1 in 100 yr. maximum hourly wind is used to establish the D_{50} of riprap material. Minimum thickness of riprap layer is one and one half times the D_{50}.

6) **Freeboard**

Crest elevation of the dam embankment and dykes is established by either the waves surcharge allowance or the maximum reservoir level produced by the project flood event, whichever is greater. In routing the project flood through the reservoir, all available outlets are considered. Top of dam and dyke is presently set at Elevation 1054.5 m. Preliminary analysis of waves surcharge and flood routing indicates that a freeboard of about 1.5 to 1.7 m at dam embankment seems adequate.

7) **Dam Embankment and Dykes**

Dam embankment and dykes crest is 12.0 m wide and gravel lined. If through traffic is anticipated then pavement may be required.

8) **Crossing of Pine Coulee and Willow Creek**

Pine Coulee crossing for Highway #527 and E-W road are identical to Alternative 1, off-stream storage. Highway #527 crossing of Willow Creek will require replacement of the existing bridge and raising the bridge crossing to a higher elevation.

9) **Service Spillway**

The service spillway consists of a gated section, chute, stilling basin, exit and approach channels. The concrete structure is 304 m long and 23 m wide. Three units of radial gates with automatic operation capability will be provided. Bottom elevation and length of stilling basin cannot be firmed up without tailwater analysis.

10) **Outlet Works**

The outlet works will serve the diversion of flow during construction, regulation of the stored water and release of the flood flow. Sizing of the low level conduit is a compromise between flow diversion requirements, construction practicality, flow regulation requirements and market availability of gate type and size. Access shaft is of wet well type. Safety ladder and landing will be provided inside the well. Metal building will shelter the well, the gate hoist and storage space for O & M purposes.

11) **Emergency Spillway**

A lower crest section at the saddle dyke provides emergency overspilling when the service spillway and outlet works are approaching their full capacity. The cut-in frequency of the emergency spillway is estimated at about 0.25 PMF. The

emergency overflow section is 120 m wide with crest at elevation 1053.5 m. The location will be firmed up to obtain adequate sheltering from prevailing winds.

12) River Diversion During Construction

River diversion works are required to permit construction of the dam embankment. Willow Creek is subjected to flash floods of high peak discharge, short duration and low flood volume. A combination of cofferdam-conduit seems appropriate. The coffer dam will be a permanent part of the dam embankment. The diverion scheme, construction staging and sequence will be firmed up so that an acceptable dam construction flood could be selected.

13) Cost Estimate

All cost components associated with the implementation of Alternative 2, on-stream storage are considered, except the engineering cost. Total project cost is estimated at $34,500,000 including a contingency provision of 15% to reflect the preliminary design stage. Cost per acre-feet stored is estimated at about $600. Cost summary per component and cost items are shown on the attached sheets.

PINE COULEE RESERVOIR

ALTERNATIVE 2, ON -STREAM STORAGE

PRELIMINARY COST ESTIMATE

SUMMARY

A	Site Services	$ 980,000
B	Dam Embankment	$ 7,900,000
C	Outlet Works	$ 1,400,000
D	Service Spillway	$ 5,900,000
E	Saddle Dyke and Emergency Spillway	$ 6,200,000
F	Highway #527 Crossing of Pine Coulee	$ 3,580,000
G	E-W Road Crossing of Pine Coulee	$ 572,000
H	Highway #527 Crossing of Willow Creek	$ 2,500,000
I	Road Relocation	$ 700,000
J	Reservoir	$ 4,500,000
	Total	$34,232,000
	Say	$34,500,000

PRELIMINARY COST ESTIMATE

COST ITEM			
A) Site Services			
1) Performance Bond	L.S.	$	80,000
2) Labour & Materials Bond	L.S.	$	40,000
3) Construction Camp & Office	L.S.	$	200,000
4) Construction Roads	5 km @ $25,000	$	125,000
5) Powerlines	10 km @ $20,000	$	200,000
6) Utilities	L.S.	$	50,000
7) Surface Drainage	L.S.	$	50,000
8) Landscaping	L.S.	$	50,000
9) Miscellaneous		$	50,000
		$	845,000
	x 1.15 =	$	971,750
	Say	$	980,000

B **Dam Embankment**

1)	Mobilization and Demobilization	L.S.	$ 500,000
2)	Care of Water	L.S.	$ 400,000
3)	Common Excavation	1,246,000 m^3 @ $1.6	$ 1,993,600
4)	Rock Excavation	18,400 m^3 @ $10.00	$ 184,000
5)	Compacted Fill	942,500 m^3 @ $1.0	$ 942,500
6)	Coarse Filter	28,100 m^3 @ $15.0	$ 421,500
7)	Fine Filter	10,500 m^3 @ $18.0	$ 189,000
8)	Road Gravel	700 m^3 @ $10.0	$ 7,000
9)	Riprap	23,300 m^3 @ $50.0	$ 1,165,000
10)	Slurry Trench	7,200 m^3 @ $100.0	$ 720,000
11)	Rock Grouting	L.S.	$ 100,000
12)	Topsoil and Seeding	6 Ha @ $7000	$ 42,000
13)	Instrumentation	L.S.	$ 35,000
14)	Road Guardrail	L.S.	$ 50,000
15)	Miscellaneous	L.S.	$ 100,000
			$ 6,849,600
		x 1.15	$ 7,877,040
		Say:	$ 7,900,000

C **Outlet Works**

1) Rock Excavation	15,000 m^3 @ $10.00	$	150,000
2) Compacted Impervious Fill	6,000 m^3 @ $2.6	$	15,000
3) Tamped Impervious Fill	7,000 m^3 @ $5.0	$	35,000
4) Coarse Filter	300 m^3 @ $15.0	$	4,500
5) Fine Filter	200 m^3 @ $18.0	$	3,600
6) Riprap	300 m^3 @ $50.0	$	15,000
7) Lean Concrete	40 m^3 @ $200.0	$	8,000
8) Reinforced Concrete	1,600 m^3 @ $350.0	$	560,000
9) Bituminous Paint	L.S.	$	30,000
10) Gate and Lift	1 Unit @ $70,000.0	$	70,000
11) Air Vent	L.S.	$	20,000
12) Safety Ladder	L.S.	$	60,000
13) Metal Building	L.S.	$	120,000
14) Miscellaneous		$	100,000
		$	1,191,700
	x 1.15	$	1,370,460
	Say:	$	1,400,000

D **Service Spillway**

1) Mobilization and Demobilization	L.S.	$	100,000
2) Dewatering	L.S.	$	50,000
3) Common Excavation	120,000 m^3 @ $1.6	$	190,000
4) Rock Excavation	10,000 m^3 @ $10.0	$	100,000
5) Compacted Impervious fill	50,000 m^3 @ $1.0	$	50,000
6)Tamped Impervious Backfill	24,000 m^3 @ $5.0	$	120,000
7) Coarse Filter	19,000 m^3 @ $15.0	$	285,500
8) Fine Filter	7,000 m^3 @ $18.0	$	126,000
9) Riprap	4,000 m^3 @ $50.0	$	200,000
10) Lean Concrete	150 m^3 @ $200.0	$	30,000
11) Reinforced Concrete	7,750 m^3 @ $350.0		2,712,500
12) Gate and Hoist	3 Units @ $220,000	$	660,000
13) Miscellaneous	L.S.	$	500,000
		$	5,123,500
	x 1.15	$	5,892,025
	Say:	$	5,900,000

E **Saddle Dyke and Emergency Spillway**

1)	Common Excavation	773,000 m^3 @ $1.6	$ 1,236,800
2)	Compacted Impervious Fill	577,500 m^3 @ $1.0	$ 577,500
3)	Coarse Filter	26,300 m^3 @ $15.0	$ 394,500
4)	Fine Filter	13,200 m^3 @ $18.0	$ 237,600
5)	Pitrun Gravel	50,000 m^3 @ $8.0	$ 400,000
6)	Road Gravel	5,000 m^3 @ $10.0	$ 50,000
7)	Riprap	39,400 m^3 @ $50.0	$ 1,970,000
8)	Topsoil and Seeding	20 Ha @ $7000	$ 140,000
9)	Road Guardrail	L.S.	$ 50,000
10)	Miscellaneous	L.S.	$ 300,000
			$ 5,356,400
		x 1.15	$ 6,159,860
		Say:	$ 6,200,000

F **Highway #527 Crossing of Pine Coulee**

1) Mobilization & Demobilization	L.S.	$	100,000
2) Traffic Detour & Control	L.S.	$	50,000
3) Common Excavation	334,000 m^3 @ $1.6	$	534,400
4) Compacted Impervious Fill	261,000 m^3 @ $1.0	$	261,000
5) Road Sub-base and Pavement	L.S.	$	42,000
6) Riprap	19,000 m^3 @ $50.0	$	950,000
7) Coarse Filter	29,000 m^3 @ $15.0	$	435,000
8) Fine Filter	23,500 m^3 @ $18.0	$	423,000
9) Pitrun Gravel	10,600 m^3 @ $8.0	$	84,800
10) Wick Drain	L.S.	$	100,000
11) SPCSP Extended & Up-graded	L.S.	$	50,000
12) Road Guardrail	L.S.	$	30,000
13) Miscellaneous		$	50,000
		$	3,110,200
	x 1.15 =	$	3,576,730
	Say:	$	3,580.000

G **E-W Road Crossing of Pine Coulee**

1) Traffic Detour & Control	L.S.	$	20,000
2) Common Excavation	37,500 m^3 @ $1.6	$	60,000
3) Compacted Impervious Fill	27,500 m^3 @ $1.0	$	27,500
4) Riprap	3,730 m^3 @ $50.0	$	186,500
5) Coarse Filter	2,850 m^3 @ $15.0	$	42,750
6) Fine Filter	1,700 m^3 @ $18.0	$	30,600
7) Road Surfacing	L.S.	$	30,000
8) Gated SCP Structure	L.S.	$	60,000
9) Road Guardrail	L.S.	$	20,000
10) Miscellaneous		$	20,000
		$	497,350
	x 1.15	$	571,953
	Say:	$	572,000

H **Highway #527 Crossing of Willow Creek**

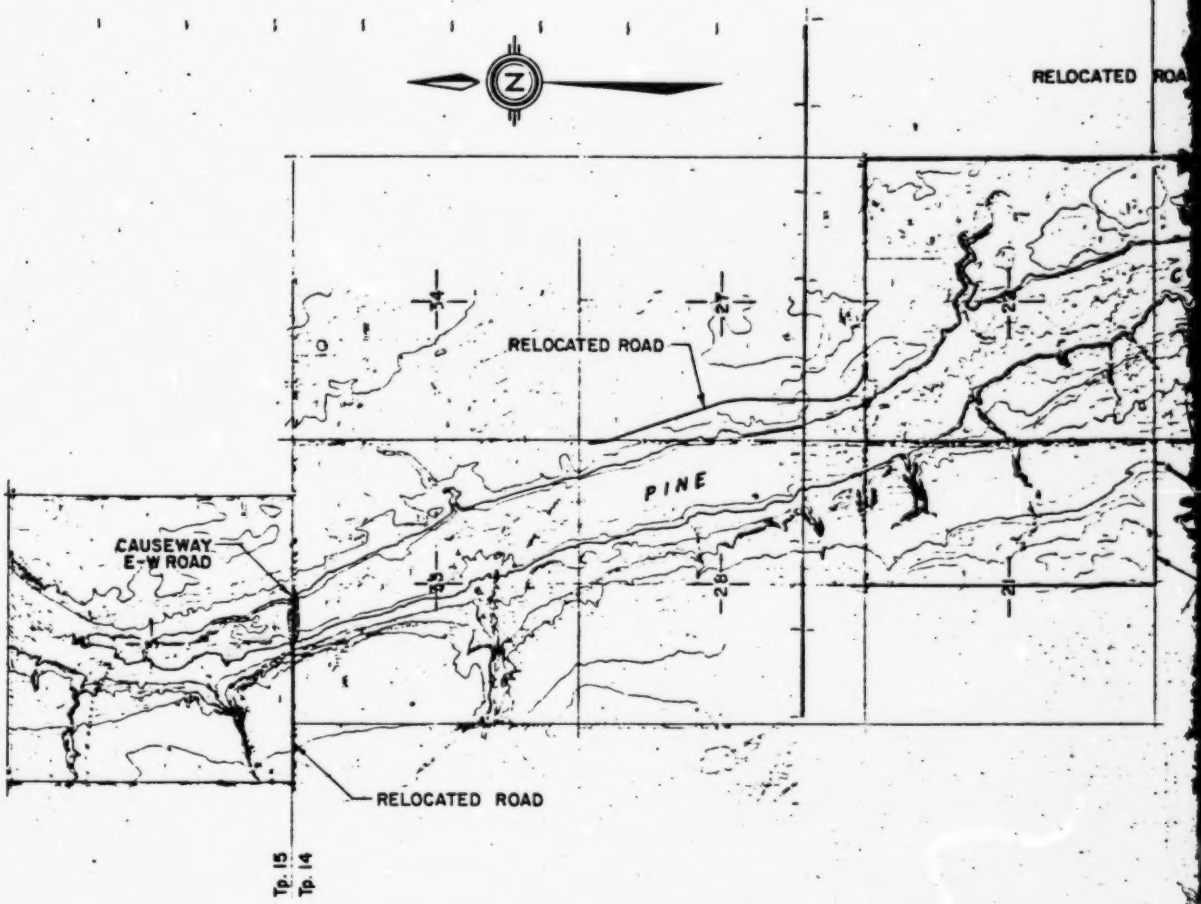
1) Mobilization & Demobilization	L.S.	$	100,000
2) Traffic Detour & Control	L.S.	$	50,000
3) Common Excavation	165,000 m^3 @ $1.6	$	264,960
4) Compacted Impervious Fill	138,000 m^3 @ $1.0	$	138,000
5) Coarse Filter	7,000 m^3 @ $15.0	$	105,000
6) Fine Filter	3,500 m^3 @ $18.0	$	63,000
7) Riprap	10,500 m^3 @ $50.0	$	525,000
8) Bridge	700 m^2 @ $1000.0	$	700,000
9) Road Sub-base & Pavement	1.1 km @ $120,000.0	$	132,000
10) Road Guardrail	L.S.	$	30,000
11) Miscellaneous		$	50,000
		$	2,157,960
	x 1.15	$	2,481,654
	Say:	$	2,500,000

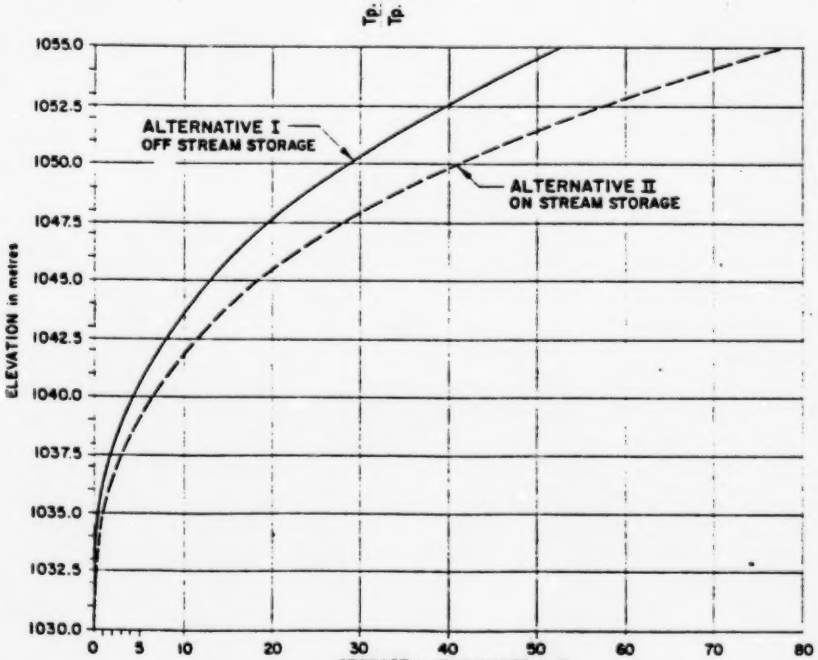
I Road Relocation

1)	Traffic Detour & Control	L.S.	$ 50,000
2)	Upgraded Gravel Road	3.3 km @ $40.000	$ 132,000
3)	New Gravel Road	4.8 km @ $60,000	$ 288,000
4)	Fencing	9,600 m @ $3.0	$ 28,000
5)	Traffic Sign	L.S.	$ 10,000
6)	Miscellaneous		$ 50,000
			$ 558,800
		x 1.15	$ 642,620
		Say:	$ 700,000

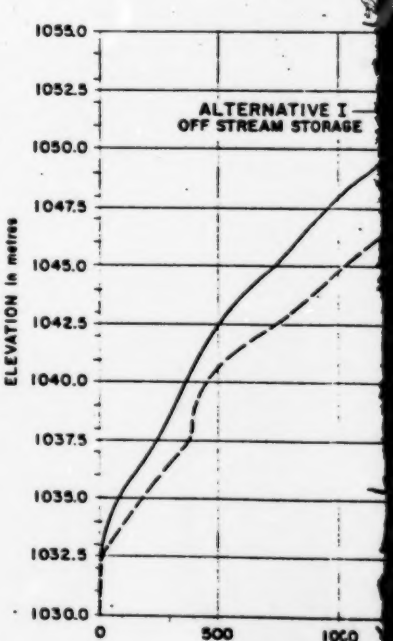
J **Reservoir**

1)	Reservoir Clearing	L.S.	$ 700,000
2)	Rim Stabilization	L.S.	$ 400,000
3)	Land	L.S.	$ 500,000
4)	Farmstead	L.S.	$ 1,000,000
5)	Wells	L.S.	$ 30,000
6)	Refencing	L.S.	$ 70,000
7)	Provincial Park Relocation	L.S.	$ 1,000,000
8)	Miscellaneous		$ 200,000
			$ 3,900,000
		x 1.15	$ 4,485,000
		Say:	$ 4,500,000





RESERVOIR STORAGE CURVES



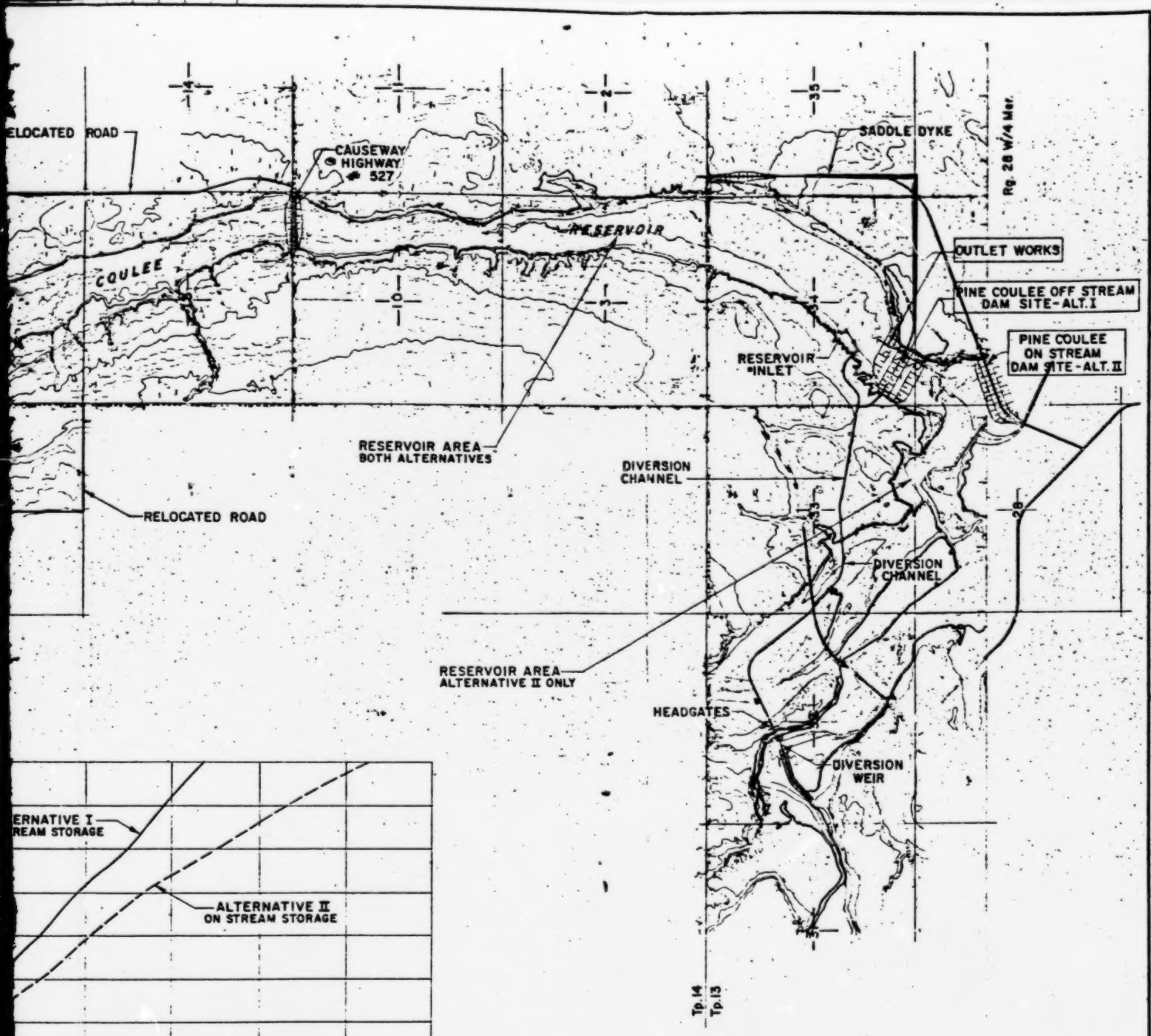
RESERV

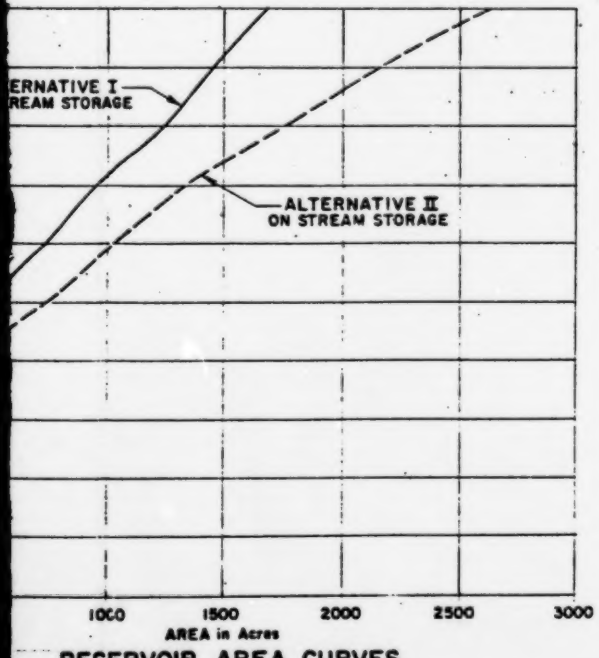
MARK	NATURE OF REVI
E	
D	
C	
B	
A	

MICROFILM DATE

DRAWING FILE No.

P1 - 36.0 x 48.0
H G F E





RESERVOIR AREA CURVES

ATURE OF REVISION	DATE	ENG.	DWN.

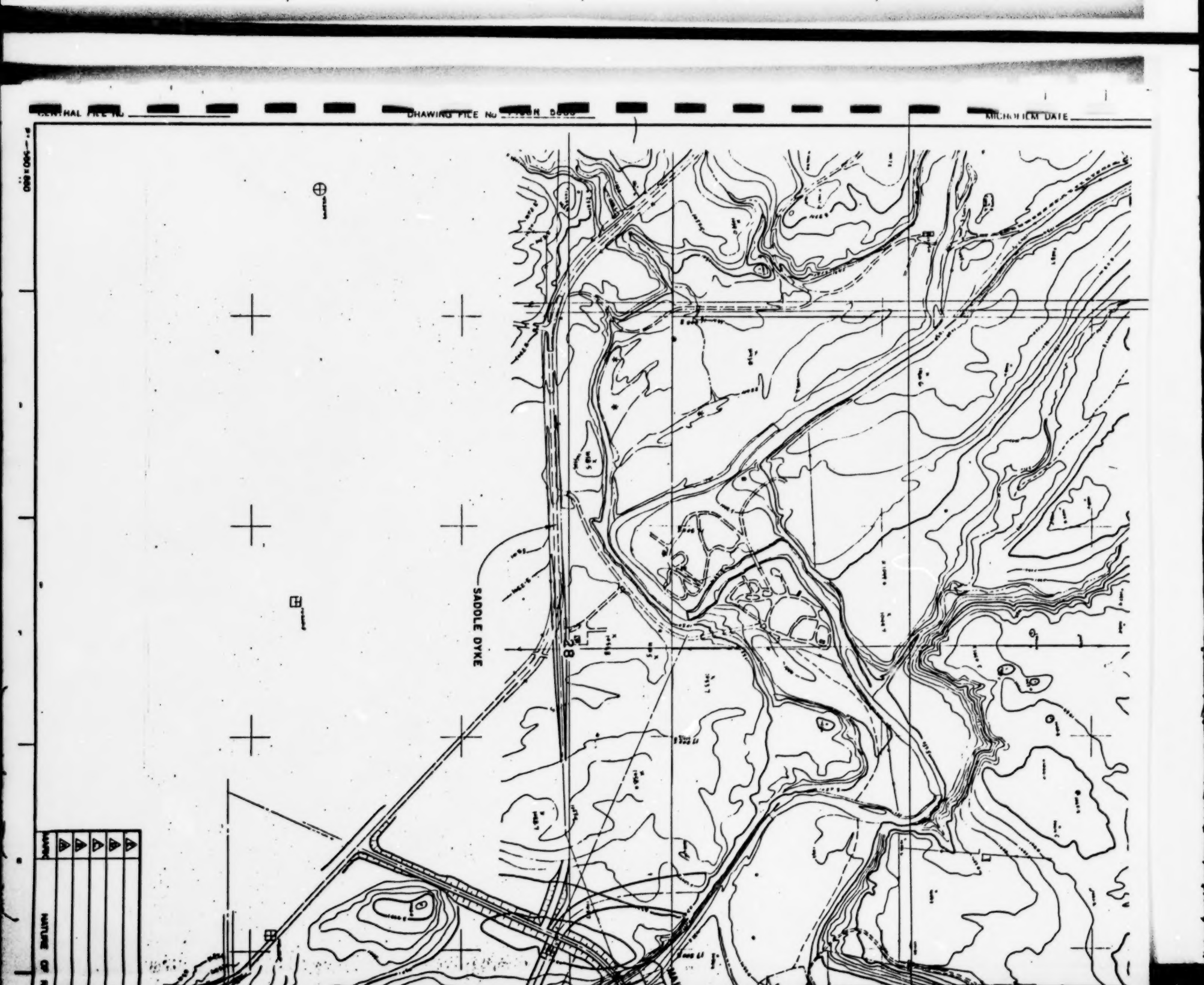
Alberta ENVIRONMENT — DESIGN AND CONSTRUCTION DIVISION

SUBMITTED	DESIGNED .....
DATE	CHECKED .....
APPROVED	DRAWN .....
DATE	CHECKED .....

WILLOW CREEK PROJECT
PINE COULEE RESERVOIR
ALTERNATIVE 2 — ON-STREAM STORAGE
RESERVOIR AREA

SCALE 1:20000	SHEET 1 OF 5
DATE AUGUST, 1985	DWG. No PICOR - E85-57

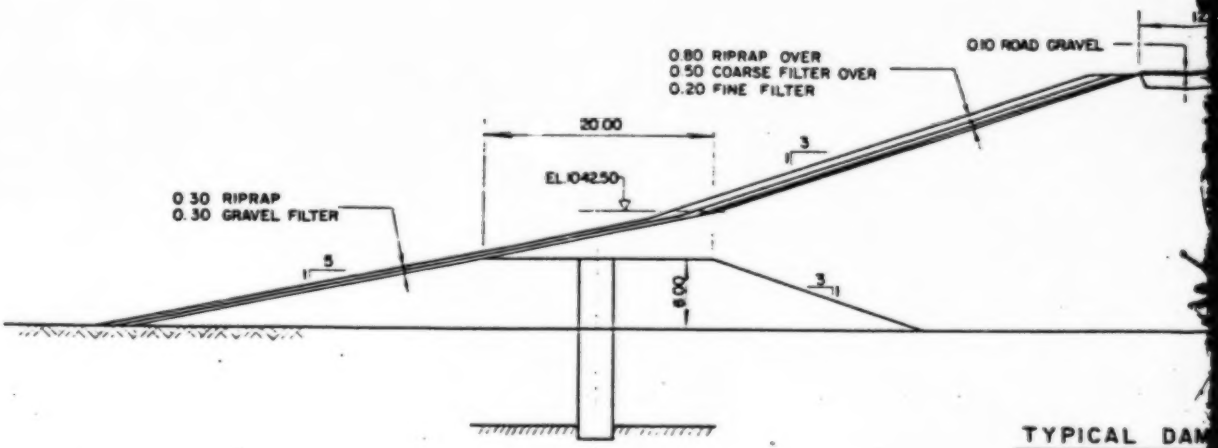
D C B A


SADDLE DYKE
28

				Alberta ENVIRONMENT DESIGN AND CONSTRUCTION DIVISION	WILLOW CREEK BASIN
					PINE COULEE RESERVOIR
					ALTERNATIVE 2 – ON-STREAM STORAGE
				SUBMITTED ..... DESIGNED	GENERAL LAYOUT
				DATE ..... CHECKED	
				APPROVED ..... DRAWN	SCALE 1:5000 / SHEET 2 OF 9
URE OF REVISION	DATE	ENG.	DWN.	DATE ..... CHECKED	DATE NOVEMBER, 1985 / DWG. No. PICOR-E85-58

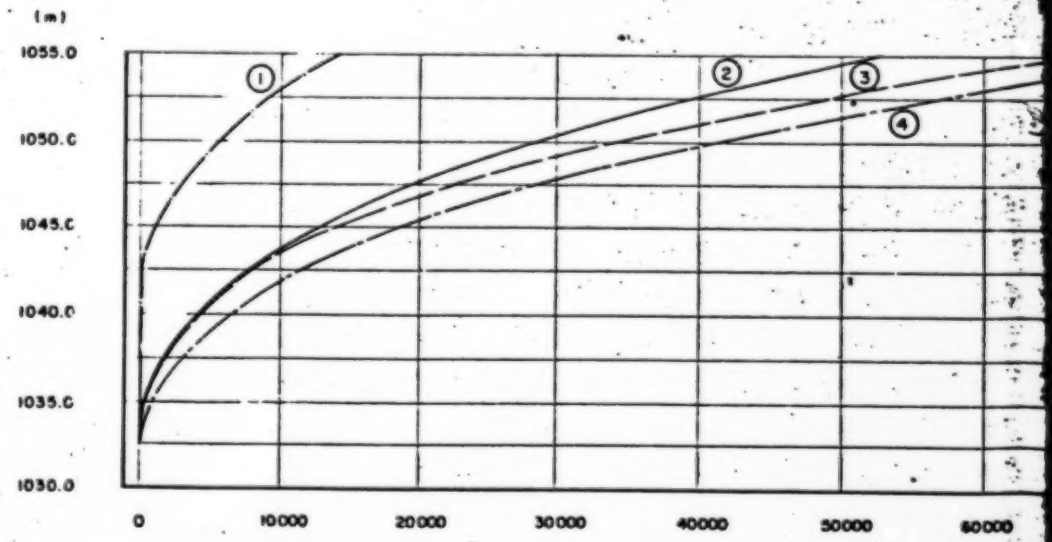
D C B A

MICROFILM DATE
DRAWING FILE No. PICOR 5985
CENTRAL FILE No.



TYPICAL DAM

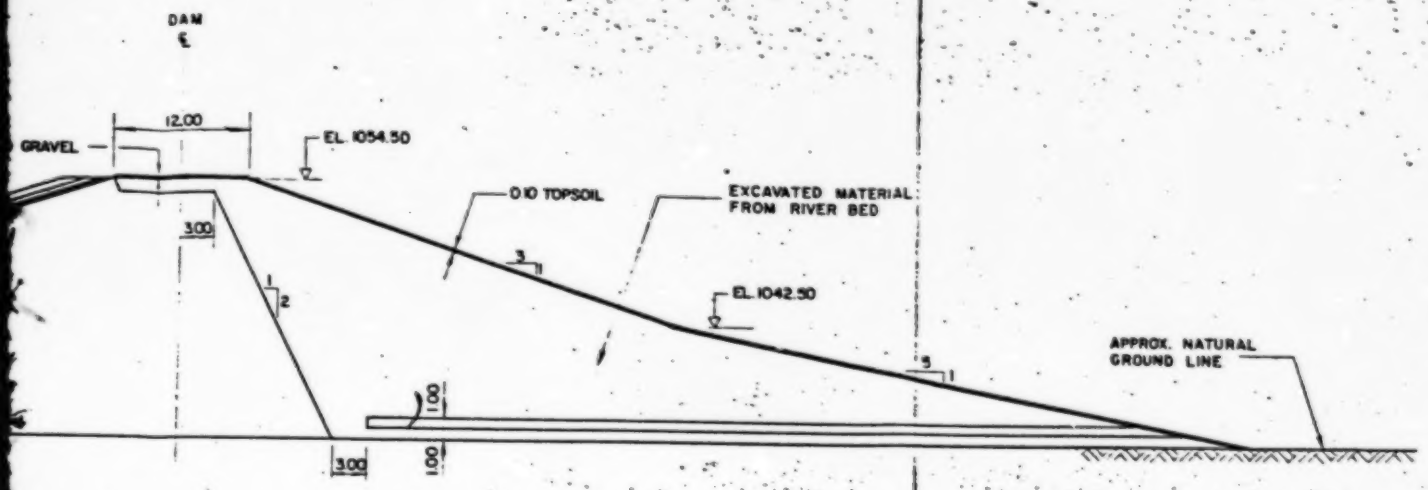
SCAL



PINE COULEE RESERVOIR - CAPACITY CURVES

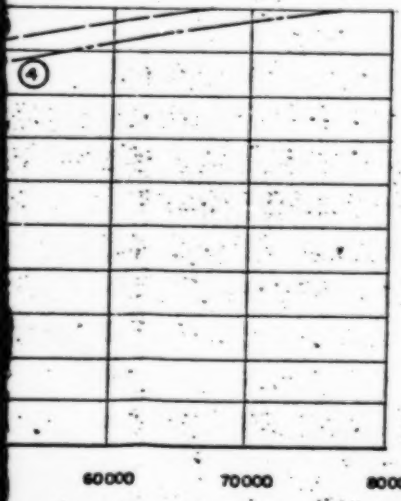
MARK	NATURE OF R
6	
5	
4	
3	
2	
1	

560 x 860 M-E



YPICAL DAM EMBANKMENT

SCALE 1:300



TY CURVES

① ONSTREAM PFRA SITE

② PINE COULEE OFF STREAM

③ ONSTREAM PFRA SITE COMBINED WITH PINE COULEE OFF STREAM

④ PINE COULEE ONSTREAM (JUNCTION SITE)

BASE MAPS: 1985 2.5 m CONTOUR

NATURE OF REVISION	DATE	ENG.	DWN.

Alberta ENVIRONMENT — DESIGN AND CONSTRUCTION DIVISION

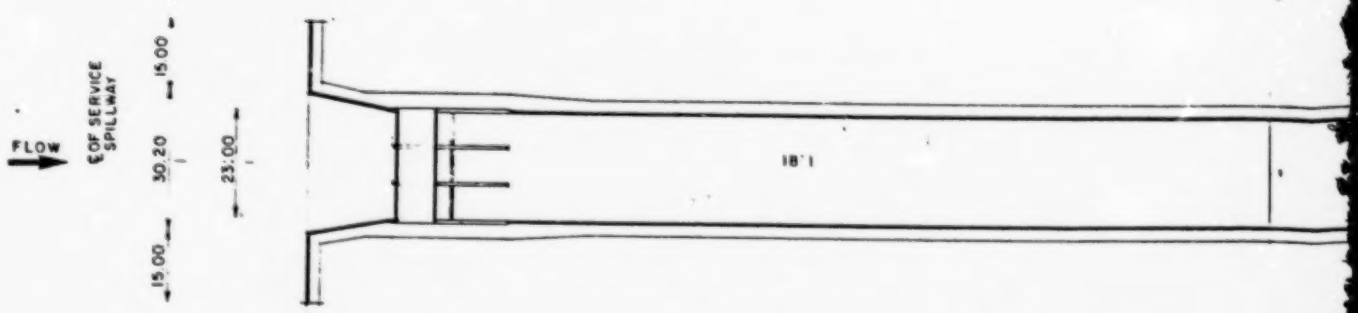
SUBMITTED	DESIGNED
DATE	CHECKED
APPROVED	DRAWN
DATE	CHECKED

WILLOW CREEK BASIN
PINE COULEE RESERVOIR
ALTERNATIVE 2 - ON-STREAM STORAGE

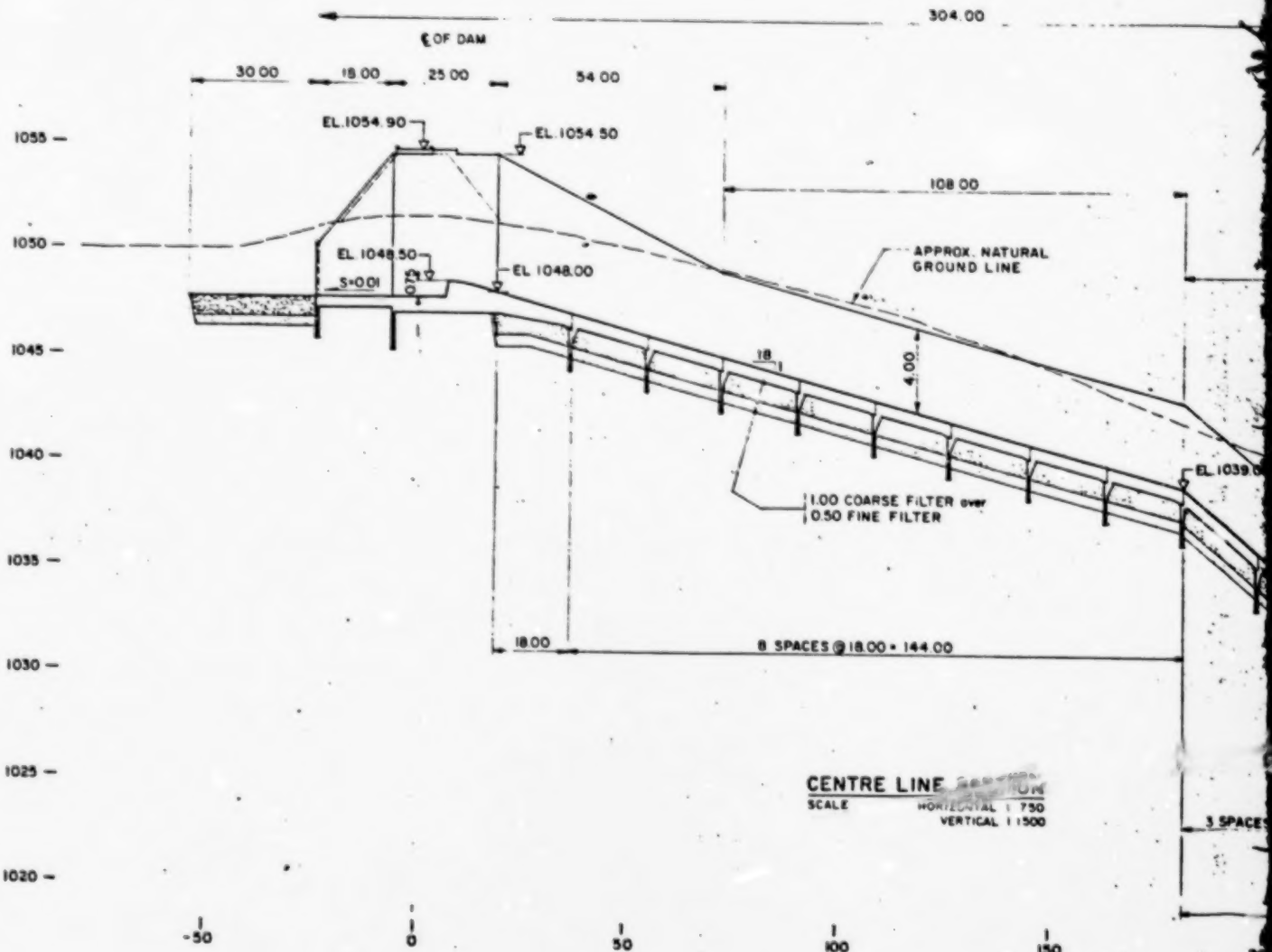
TYPICAL DAM EMBANKMENT AND CAPACITY CURVES

SCALE AS SHOWN	SHEET 3 OF 5
DATE	DWG No PICOR-E85-59

D C B A



PLAN
SCALE 1:750



CENTRE LINE SECTION
SCALE HORIZONTAL 1:750
VERTICAL 1:1500

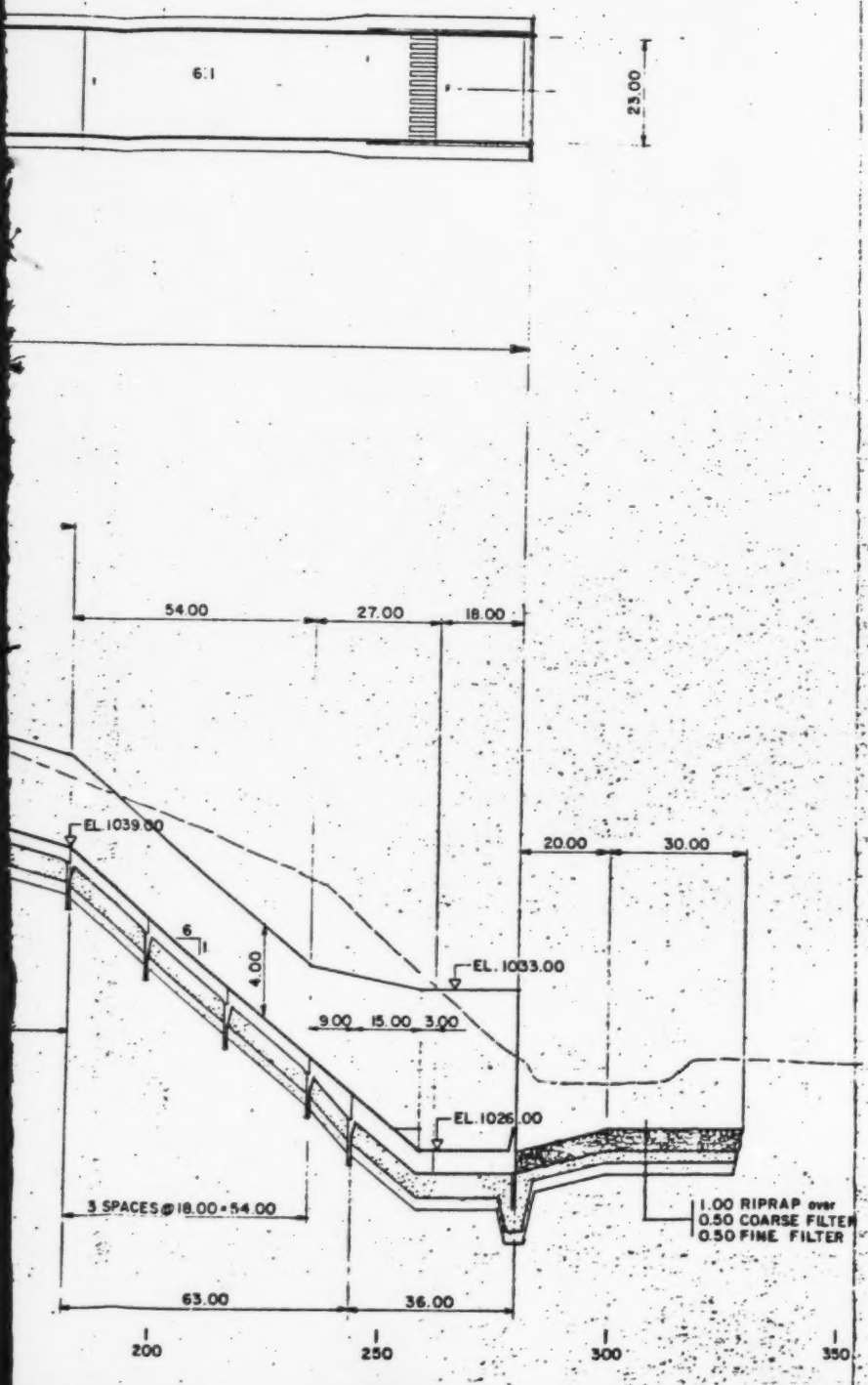
MARK	NATURE OF REVISION
E	
D	
C	
B	
A	

DRAWING FILE No PICOR 6085

CENTRAL FILE No

MICROFILM DATE

560 x 860 H-E



ATURE OF REVISION	DATE	ENG.	DWN.	

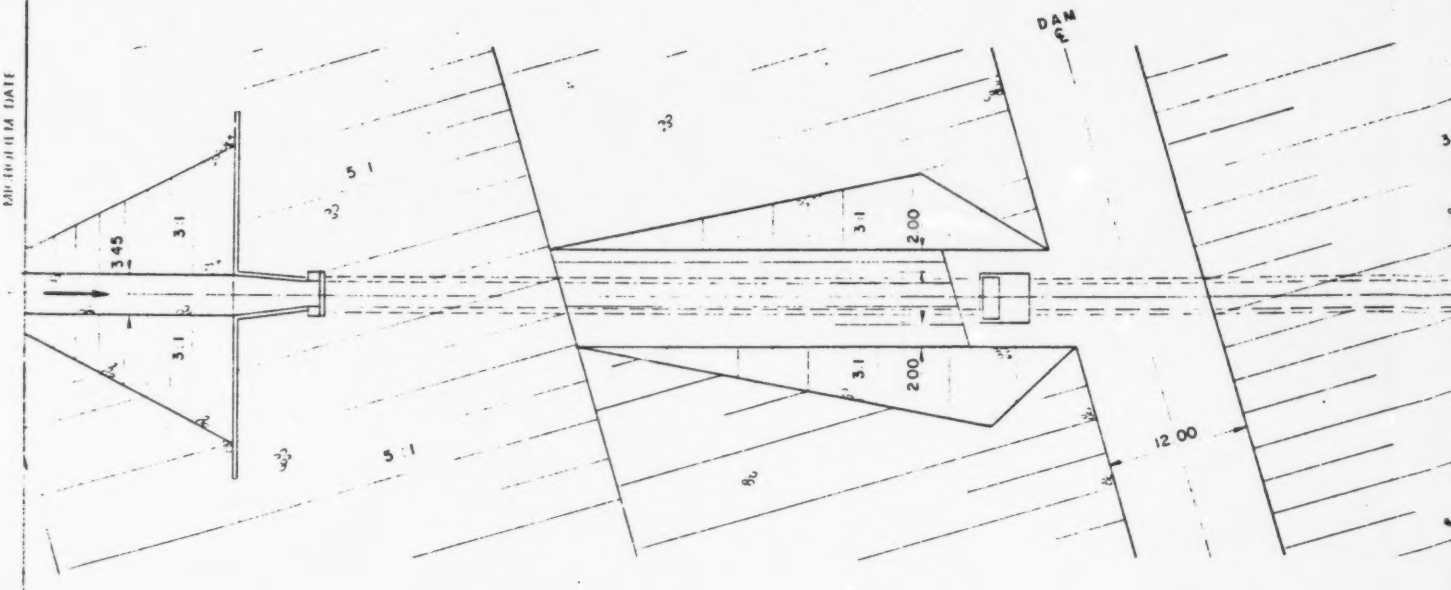
Alberta ENVIRONMENT — DESIGN AND CONSTRUCTION DIVISION

SUBMITTED	DESIGNED
DATE	CHECKED
APPROVED	DRAWN
DATE	CHECKED

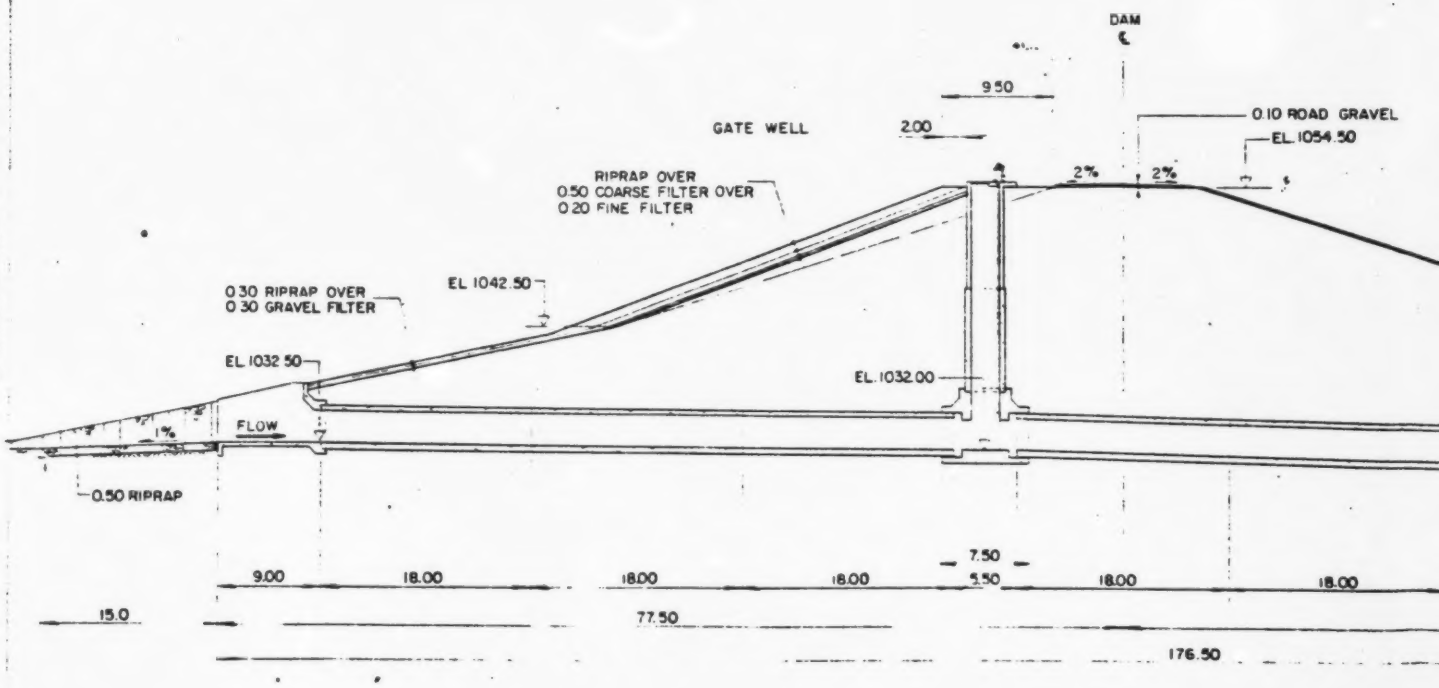
WILLOW CREEK BASIN
PINE COULEE RESERVOIR
ALTERNATIVE 2 – ON-STREAM STORAGE

SERVICE SPILLWAY

SCALE : AS SHOWN	SHEET 4 OF 5
DATE : NOVEMBER, 1985	DWG No. PICOR - E 85 - 60



PLAN

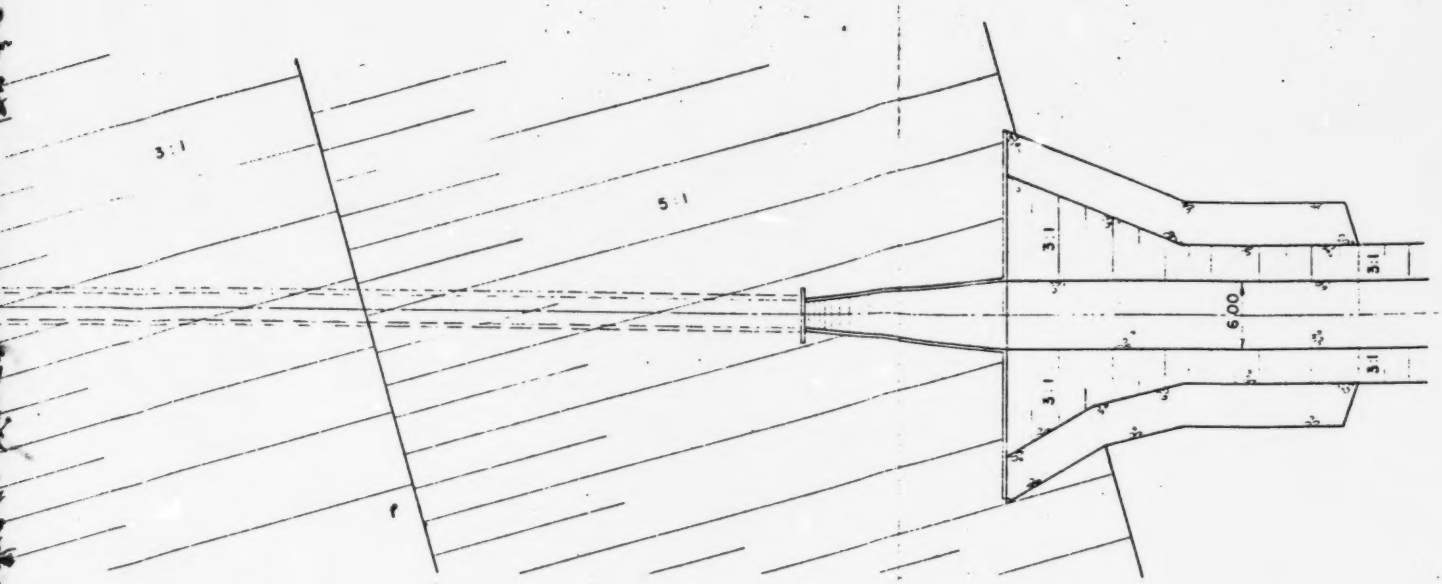


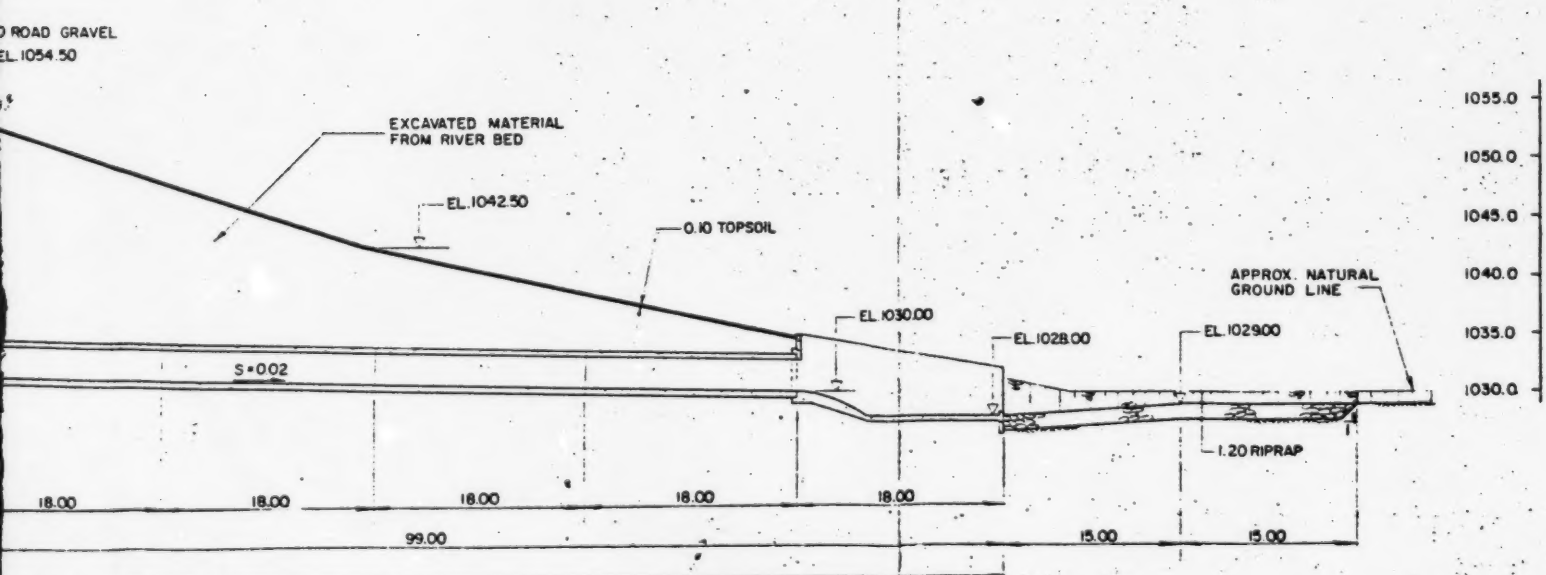
CENTER LINE SECTION

E	
D	
C	
B	
A	

MARK NATURE OF

DRAWING FILE No. PICOR 6185





NOTE:
COLLARS NOT SHOW

NATURE OF REVISION / DATE / ENG. CHK.	Alberta ENVIRONMENT — DESIGN AND CONSTRUCTION DIVISION	WILLOW CREEK BASIN
	SUBMITTED / DESIGNED	PINE COULEE RESERVOIR
	DATE / CHECKED	ALTERNATIVE 2 — ON-STREAM STORAGE
	APPROVED / DRAWN	OUTLET WORKS GENERAL LAYOUT
	DATE / CHIEF	SCALE 1:300 — SHEET 5 OF 5
		DATE NOV 1985 — DWG. # PICOR - E85 - 61

POOR
QUALITY
ORIGINAL